DISCUSSION

FRANK V. THOMPSON, Assistant Superintendent of Schools, Boston.—A year ago we were deliberating on the question whether the element of vocation in education seriously threatened our cherished cultural ideals. You may recall that it was hard work to raise an issue—and that apparently all the opinions expressed were upon the negative. In a short year, educational attention has focused upon the question of educational products—their extent, reality, and values. Contemporaneously in industry and business has come the movement known as scientific management. It is a favorable sign to note that education today is so sensitive and responsive to the spirit of progress outside academic walls. Modern education feels that all the influences, inventions, and improvements of promise affecting extraneous agencies are of vital importance to the school. Modern education is human, no longer merely scholastic.

Education today wishes to be efficient, as industry is efficient; education wishes to know what the product is, and to gauge the time, quantity, and value elements. We speak in education today of vocation and culture. We are going to define the terms, and we are going to see that we actually produce what we say we are doing. We are going to determine the ratio of product and time; we are going to define standards; we are going to eliminate waste—in a word, we are going to try to be efficient, in conformity with the world-wide ideal of efficiency. But efficiency we know is a relative term. There is only one way to determine efficiency, and that is by measurement. Education cannot assume an efficiency-ideal without adopting its concomitant, namely, measurement. Hence our particular consideration this morning rests upon the topic of tests of school efficiency.

Indeed, it may be admitted that the school has always sought to gauge its products; the accumulation of school statistics has grown to be enormous. We have our figures dealing with examinations, attendance, promotions, retardations—in a word, a very definite system of educational measurement.

Why, then, the need of a new system of measurement, it may be asked? The answer probably is this: The measurements employed in the past were not fundamental. These measurements dealt with standards peculiar to the school; they did not vitally touch life. Our standards have lacked objectivity and could not be interpreted in the common terms of life-activities and experiences. On the other hand, our school standards have not even achieved their own limited ends, and the defects and limitations of school statistics are becoming increasingly apparent, particularly when measured by newer standards. School statistics today stand properly indicted.

Now, like all movements receiving temporary emphasis in education, the present exaltation of measurement will need to run the gauntlet of its predecessors. There will be scoffers and zealots, and those who will wisely profit. It

is easy to point out evident dangers. Measurement in education presupposes commensurable quantities, and many of the best products of education are incommensurable. There are spiritual and there are material products of education. Over the first of these there will be ever the veil of mystery and doubt. Man spiritually has always been the enigma of existence, and will continue to be so. We can never plot the curve of genius nor measure the unit of inspiration. But a vast amount of educational effort is measurable, and a wiser method of measuring it is to be welcomed.

Our discussion today deals with the measurable products of education. In devoting our attention to such matters, we do not for a moment lose our sense of values, of the higher, constant, and general aims of education. These values are measured only in the lives of citizens, in the creations of genius, and in the greatness of nations. It is best to begin on things which all agree are measurable. It may be that we shall see the extension of the possibility of measurement over many fields of what we now consider the spiritual side of education, but to assume that all activities are measurable would be inexpedient, to say the least, and, to my mind, unfortunate.

But in the undisputed field of measurable quantities, I believe that we are bound to overhaul the present means of measurement of educational facts and products. The day of the educational engineer is at hand. Methods, programs, procedure, time-allotments, the whole machinery of education, will be subjected to investigations and tests which will upset many time-honored assumptions. The day of educational opinion will go—and the sway of dominant educational personalities will be much limited. Education today is an incipient science. If the educator of the future takes advantage of his opportunities we may have, perhaps, an actual science. But I am not so confident as some of the speakers seem to be, of seeing the certainty of education being an exact science in my own day and generation.

Now I think I have challenged, in a way, the apparent opinion of both the papers that all products of education are measurable. It is possible to submit certain tests of spiritual values; but such tests must be suitable to the nature of the spiritual product. We naturally come to philosophical questions when we consider any fundamental question. The difficulty is this: when you attempt to measure the purely spiritual by something purely material you have no common unit. There are no common relationships. Many products of education are objective, and here measures may be applied with profit.

FRANK E. SPAULDING, Superintendent of Schools, Newton, Massachusetts. —As a school administrator charged with the responsibility of the general direction of an educational enterprise whose function it is to take a certain type of raw material and turn that raw material into a finished, or improved, product, I am greatly interested in the problems that have been raised and discussed here this morning, the problems of establishing standards for the

definite measurement of educational results. The school administrator, even more, perhaps, than the teacher, appreciates the importance of comparing results secured under different conditions, of determining their relative values. It is, indeed, a fundamental part of administrative work to make such comparisons constantly. At present, the school administrator is forced to guess at values, to rely chiefly upon his individual opinion, just as teachers do when they mark a pupil's paper. So, as a school administrator, I want to express my hearty appreciation of the purpose and the spirit of the studies which these pioneers are undertaking, studies that are to furnish definite standards of educational measurement.

I want to speak briefly of a standard to which educational products are, must be, constantly referred by the school administrator, and to suggest the great importance of definite educational measurements in connection with this standard. I refer to the financial standard. What does it cost to produce a given result? Of two results produced by equal expenditures of money, which is the more valuable? What investments of money bring the largest returns? How may the money available for the maintenance of a public educational enterprise be used to produce the most valuable results? These are extremely practical educational questions from the administrative standpoint. Whether or not we like even the suggestion of referring educational values to the expense in dollars and cents that went into the production of those values, such reference we must make constantly in practice, if we would conduct efficiently this productive enterprise in which we are engaged.

Now if objective standards of measurement can be worked out and applied in place of the standard of personal opinion, we shall be able to tell with a degree of certainty how to expend educational funds to the best advantage; we shall be able to determine what expenditures bring the largest returns. Let me illustrate with a few concrete facts.

As a part of the educational enterprise for which I am somewhat responsible, there are two high schools, an academic high school and a technical high school. In these two high schools are taught a large number of different subjects, grouped into eight or ten distinct courses. The cost of providing a definite unit of instruction varies quite markedly in the different subjects and in the same subjects in the two schools. Taking as the definite unit five recitations a week for one year—that is, two hundred recitations—for a single pupil, we find that the cost, at the present time, of this amount of instruction in history is in one high school $10.20, in the other $11.80. Is the product in one school worth 15 per cent more than that in the other? It costs that much more. In one school it cost last year $10.60 to give a pupil two hundred recitations in science; in the other school this year it is costing $16.69 to furnish the same amount of instruction in the same subject. Is the product secured at this higher expense worth 57 per cent more than the product secured at the lower expense? It is costing that much more. In the same school it is costing $8.20 to provide one unit of instruction in commercial subjects—

stenography, typewriting, bookkeeping, etc.—while it is costing $17.60 to provide the same unit in household economics, and $17.93 in shopwork. Are the educational products worked out in the kitchen and the shop worth 115 per cent and 119 per cent more respectively than the product of the commercial rooms? They are costing that much more.

At the present rates it is costing $201.90 for the instruction necessary to put a pupil through the classical course, $206.24 to put one through the scientific course, and $219 to put one through the general course, in the Newton High School; it is costing $269.77 to put a boy and $281.63 to put a girl through the technical course, $336.92 to put a boy and $319.08 to put a girl through the extra-technical course, and $191.67 to put a pupil through the commercial course in the Technical High School. Here are extreme variations of over 75 per cent in the cost of instruction in the different courses in the same school. How do the educational values produced compare? When we are in possession of such objective standards of measurement as the discussion this morning leads us to anticipate, we shall be able to answer these questions and scores of similar questions with confidence. But while we are awaiting these standards, we must still answer these questions as best we can. The questions will not wait. We may refuse to face such questions squarely and to answer them consciously, relying upon such grossly imperfect measurements as we are now able to apply—and I suspect this is what most of us do; we may refuse even to formulate such questions; yet we cannot avoid answering them in some way in our practice of school administration.

When the differences in cost are quite extreme, we do not find it so difficult to bring ourselves to a decision concerning the relative values of the products secured from the expenditures. When it was discovered a few years ago that it was costing about a hundred dollars to furnish instruction in Greek to a single pupil—two hundred recitations—we did not hesitate long in our answers to such questions as these. Which is more profitable, to teach ten pupils English, nine pupils history, eight pupils German, ten pupils mechanical drawing, six pupils household economics, or one pupil Greek? In spite of some sentimental prejudice in this matter, to which I am willing to confess, I could find but one answer to all these questions, and we are now investing our money in educational products produced by other studies than Greek. Are we making a mistake? Perhaps so. Hasten the day when we shall have objective standards of measurement on which we can rely!

EDWARD M. HARTWELL, Secretary, Statistics Department, Boston.—When asked to take part in this discussion I was in doubt whether I ought to accept the invitation, as I could only guess at what the papers in the program might suggest to a mere statistician. However, I decided to chance it, as I had other reasons for being interested in a meeting of this Association.

I was a teacher before I became a worker in statistics. Moreover, as a teacher I was one of those who enjoyed the privilege of attending as a student,

in 1874, the second session of the Summer School in Zoölogy, which Professor Louis Agassiz had started the year before. And in 1875 I was with Professor Shaler's Harvard School of Geology at Cumberland Gap, in Kentucky.

Thanks to the initiative of Professors Agassiz and Shaler, Harvard University, a little later, established laboratories and museums for teachers of this vicinity, thus providing the material out of which this Association has grown and developed.

Even in those days criticism of the secondary schools and their curriculum found voice, although no one had the hardihood to avow a belief in scientific pedagogy. I remember a meeting of the High-School Teachers' Association at which the professor of English in the Institute of Technology, then in its callow youth, vigorously attacked the study of Greek and such like rubbish, which attack was warmly repelled by President Eliot.

Wendell Phillips argued that the public schools ought to make a place in their curriculum for vocational training; but his doctrine was so novel and heretical that he made but slight impression on public opinion. Meanwhile the times have greatly changed. Latterly dissatisfaction with the ideals and methods of the secondary schools, and of our colleges and universities, has grown apace. Criticism of results has become clamorous, and discordant as well. The practical man, so called, is especially insistent in his demands for results, such results as the wayfaring man, though only self-educated, can comprehend and approve.

Go to, cry the apostles of business efficiency and cost-accounting; let us standardize the schools in conformity with the maxims of the market-place and the manufactory, so that we can measure and appraise their output.

Doubtless the scientific admeasurement of measurable quantities may be made to yield valuable criteria of the efficiency of certain methods and procedures pertaining to school life and administration. But the measurements must be made by patient and skilful measurers, who can be depended on to winnow and classify their results and not jump at conclusions.

My inclination is to welcome the attempt to extend and render more fruitful the field of school statistics, in which precisely determined, commensurable and comparable data are none too common. Such attempts compel my sympathy and respect. As a statistician one is most largely interested in things that can be counted and measured, and then be so classified and discriminated that their quantitative and causal relations may be determined and interpreted. But I must confess that the glowing accounts of the rapid spread, in the last few years, of comprehensive statistical investigations of schools and scholars does not elate me overmuch. Supposedly professional statisticians not infrequently do such queer things that the prospect of a possibly too-rapid multiplication of amateur school statisticians is not inspiring.

Only a few weeks since, one of the Boston newspapers printed a disturbing statement that, according to the United States Bureau of the Census, the death-rate of Boston for 1911 was 18.5 per thousand of population: the highest of

the eight largest cities in the country. The Census people early in the year, doubtless to impress the public with their up-to-dateness, published a series of death-rates for 1911. But they gave out the Boston death-rate without waiting to ascertain the actual number of deaths in 1911. They estimated the number of deaths for the last third of the year on the basis of the deaths previously recorded. The actual death-rate for the year, using the same estimated population, figured out at 17.1, or 1.4 less per thousand living than the Census' figure. Moreover, due allowance for the very exceptional month of July was not made in the Census estimate of deaths. Deaths in Boston last July numbered 1,270—of which 216 were from the effects of heat—or 345 more than in July, 1910, when there were no fatal heat-strokes. Official estimates of population on a basis for computing annual death-rates are sometimes astonishingly wide of the mark. I knew a health officer who for three consecutive years figured his death-rates on an estimated population of 541,000 (which figure he obtained from a newspaper); but the United States Census enumerators could find but 508,957 people in the city in the third year, which was a Census year. In another large city for three consecutive years 405,000 was used as a basis for computing the death-rate. A year later the Census enumeration amounted to only 325,902, so that the death-rates for the preceding three years were from 3.6 to 3.8 per thousand too low.

When such things are done in the dry tree, what may we not expect in the green?

Undoubtedly there is room for improvement in the matter of keeping school records and the compiling of attendance statistics. There is good reason for the suspicion that the Massachusetts statistics of school attendance have been misleading, particularly as regards the numbers entering and leaving school within a year. The original *Massachusetts School Register* was devised in the thirties by Mr. Lemuel Shattuck, of Boston, a versatile and competent statistician; but he gave no place in it for recording the death of a pupil. Tardiness and absence bulk large in our school records; but they afford us no data for estimating, much less computing, the mortality of either city or country children. So far as I know, they do not enable one to measure the loss of time in the schools caused by disease in general or by school-diseases in particular. If Mr. Ayres knows of any city in the country where the school authorities or the vital statisticians record the deaths of school children, I should like to know its name. I submit that it is high time that the advocates of uniform school records should set about securing data to serve as a basis for comprehensive and trustworthy mortality and morbidity statistics of the school population.

It is not a very difficult matter to pile up figures as to school accommodations and the physical conditions of schools in certain cities. We have recently been informed, as the result of a hygienic survey, that 65 per cent of the school population is below par—does not come up to the normal standard. Dr. Richardson, a prolific English writer on hygiene, used to say that he never saw

a healthy child. Well, one can define and refine his standard of health so that ideally proportioned and endowed persons would be too few to furnish an adequate supply of museum specimens. All of us know a good many healthy children. Any child or man may be pronounced healthy so long as he can do his daily work easily as often as the day's work comes around. When one scrutinizes the statistics which stigmatize two-thirds of the Boston school children as below the normal standard in physique and health, much comfort may be had from the fact that the defects are not organic or constitutional, but of a relatively unimportant sort, like neglected teeth, squint, *et cetera*.

Many a well-meant statistical investigation has broken down because the schedules of inquiry were ill-devised, too elaborate, or too minute. Granted that the data for tabulation are trustworthy, the classification and arrangement of data in congruent groups calls for insight and skill no less than for industry and patience. Sound statistical work is so expensive at every stage that thrifty shopkeepers and efficient inquirers are prone to condemn it, because, according to their lights and standards, results appear incommensurate with their cost.

When I hear that state-wide investigations of schools or school children have been completed in a year, I cannot forbear wondering how many of the investigators were experts, where they came from, how much money they spent, and what they really accomplished.

I believe in putting searching questions when there is a prospect that they will elicit honest and intelligent replies. There is urgent need for determining whether school life stunts or stimulates the normal growth and development of the average school child in respect to body and mind. The ever-increasing demands of the schools upon the tax-levy make it imperative that economic leaks in their administration shall be located and stopped. At present opinion is divided and uncertain as to the functions of the schools and what they should accomplish. In these fields of inquiry exploration must necessarily precede research. Thus far we have had more exploration than research.

In view of the present state of the arts of exploration and research, I am rather glad that the supply of well-equipped school hygienists and statisticians hardly warrants school authorities in adopting ambitious schemes of investigation on a large scale; else we should have a deluge of ill-digested and misleading comparative statistics. The public is inordinately fond of the vain comparative, particularly in its interpretation of statistics relating to population, health, and wealth. How often one finds statistics adulterated or distorted to enable a community or an institution to brag over its compeers!

It is natural that popular education should be influenced by the currents and cross-currents of popular opinion. Just now popular opinion is running strongly in favor of industrial training and commercialized education. Those who are responsible for the guidance of popular education will doubtless be forced to engage in self-examination and to investigate in various directions in order to meet the criticisms and demands of the apostles of business effi-

ciency and to attempt to frame their answers in terms of units of energy and units of cost.

Here in Massachusetts, without due investigation or a well-reasoned plan of reconstruction, the State Board of Education has been revolutionized. Thus far there appears to be no consensus of expert opinion as to the meaning of industrial education, where it should begin and end, or how it should be conducted. Our present predicament seems to me largely owing to the impatient spirit, muddled notions, and hustling methods of the business world. It is only recently that business men have awakened to the commonplace truths that underlie the gospel of business efficiency. So long as most investigations of political corruption lead up to a business man or a group of them, one may be pardoned for some hesitation in accepting business men, as such, at their own valuation. It may be seriously doubted, too, whether, at the present stage of their mental and spiritual development, they are likely to prove the most intelligent and helpful reformers of our school system.

It seems to me that the essential problems of education are problems concerning growth and development; and that in our attempts to evaluate and appraise the results of instruction and training we should strive to adopt such standards of measurement and comparison as are applicable to living beings and their activities, and eschew as inapplicable the criteria by which the efficiency of the builders and operators of dead machines is properly judged. Statistical problems that relate to the development and actions of human beings and of potential and social institutions are the problems which appeal to me most strongly, because I was a biologist before I became a statistician. My plea is that we should discriminate in our investigation and consideration of educational matters between methods and criteria that are applicable to living mechanisms and their activities and those which pertain to the realm of the inventor, the engineer, and the manufacturer.

Lest I seem to be a reactionary and a skeptic, let me express my interest in the papers presented here this morning. The first embodied an attempt to devise a workable method of assigning quantitative values to impressions and qualities. While recognizing the interest attaching to the problem as an exercise in logic and philosophy, I confess that I should not dare to put the proposed scale to a practical use, without receiving careful instruction from Dr. Thorndike.

With Mr. Ayres's main thesis, as I understand, I am in substantial accord. His paper is a very suggestive one. I hope I may have an opportunity to study it carefully. Possibly such study may modify my belief that a preliminary campaign of education as to the nature and limitations of the statistical method is desirable, if trustworthy and illuminative results are to be secured by such extensive investigations as Mr. Ayres advocated.

STRATTON D. BROOKS, Superintendent of Schools, Boston.—I observe that the audience is getting nervous. Perhaps it is well to close this discussion, except for the privilege of the chairman to contribute his mite.

I feel that the school administrator is confronted with a very difficult situation, in that his cost is measurable and his product is not measurable. The public, the business man, the taxpayer knows exactly how much school supplies cost, and how many are furnished, but we are unable to prove to him that the school is delivering a product that is as good as it was forty years ago.

I have been interested, of course, in calling the attention of some gentlemen to the records in my office of the schools of long ago. In fact, we were investigated, and the investigator came with the attitude that the school was not delivering the product that it was bound to deliver. I pointed out to him the forty-five volumes, more or less, that I have, in which I have every paper that was written in an examination long ago in the schools of Boston; and I challenged him to take any book at random, and I would guarantee that any pupil in the eighth grade could write better than any pupil in the file. He did not believe it until he looked at the book; but it was true; and he admitted it at once. He went through it and found page after page upon which the pupil had answered every question with "I don't know." He went farther, and found that whenever a pupil made a mistake in an examination, the same mistake occurred in every paper through the book, which indicated a very radical difference from the methods of education of today; namely, that in that day they learned the answer by heart, and if they knew it, all right; and if not, they wrote down "I don't know." If they had learned it by heart, every last one of them wrote it alike, and incorrectly.

I want to emphasize that the investigations may possibly help us. It may enable us to show that after all the school has a measurable product in some of its phases. We may be able to call in some of the experts who possess ability to inspect the schools; we shall have sufficient material to be able to approach the business man with a certain demonstration that we know something about our business, whatever the statistics are, and as bad as we know they are. Even an investigation, as bad as some of them are, may have this advantage—that the conclusions, if any are made, will be so confusing that the business man cannot understand them; and it will therefore be a valuable asset in our defense of the public schools.

I remember that in 1851 a superintendent of schools for Boston was appointed, and it was enacted that he should be "a genial influence on our schools, but should not otherwise interfere with their operation." In 1912, we have investigating committees which seem to be irritating influences on the schools but do not otherwise interfere with their operation. What shall we do about it? What is the use of taking time and energy for investigation and having nothing come of it? What is the use of coming to this discussion and going home and not doing something about it? The fact is, that, as Mr. Hartwell said, we ought not to be so anxious to know what the other fellow is doing, or whether he is better or worse than we are, but what we are doing ourselves and why we are doing it. If these things can be reduced to terms of measurement, we want the measure made by those men who have the time and

ability to figure it out and bring it to us. If Professor Thorndike can show us a plan whereby we can measure our product, we want it; we want instructions how to use it. For those things not yet reduced to a money standard, we want the judgment standard at least. Here is the difficulty. Some of you believe you cannot measure thought progression in English composition. Professor Thorndike says they are beginning to work out a measure. The trouble is, that those teachers who say it cannot be measured will nevertheless mark one composition 76 and another 76.5. They have done it for years; refusing graduation to pupils who got 74.5 and graduating those who got 75. Now to be sure, we may not get the exact standard ultimately, but we are going to get something more intelligent at least than estimation from the judgment standard. Eighty per cent of the people might agree that one composition was the best one in the lot, and that another was second best, and so on; but 90 per cent of the teachers want to mark on the basis of whether it expresses what the *teacher* has in his mind. The essential point in the estimation of the composition is what the child had in his mind and whether what the child said was 80 per cent or 90 per cent of what the child knew. Since none of you can know what that particular child knew about that particular thing, you can never know whether he expressed 70 per cent or 80 per cent of his own thought. The chances are that he expressed 100 per cent of what was in his mind while he did the writing. He may have known more about it the day before or the day after, but when he was writing, he was putting down all he knew then.

One or two words more and I have done. Some time ago, we tried to find out with regard to the financial condition of the Boston public schools because we wanted more money than the authorities in the City Hall and in the Legislature would allow us. We found no city in the United States that had statistics about finances that were anywhere near true or had anything to do with the real facts. They had averaged the evening-school pupils at $5 each, grade pupils at $35, high-school pupils at $100 each, and struck a general average. And they knew so little as to believe that that would tell the truth, when it was readily possible, by changing the percentage of pupils, to spend $2 per pupil more on every pupil in the school and have a smaller average at the end of the year; or, reversing it, to spend $2 less and have a larger average. Consequently, we have attempted to revamp that somewhat. Those of you who are principals of elementary schools in Boston know that we know and you know exactly the amount spent in such schools and upon what items. That has come to be a very valuable form of statistics.